REQUEST FOR ADDITIONAL INFORMATION (RAI)

BY THE OFFICE OF NUCLEAR REACTOR REGULATION

TOPICAL REPORT (TR) EMF-3028(P)

"RAMONA5-FA: A COMPUTER PROGRAM FOR BWR [BOILING WATER REACTOR]

TRANSIENT ANALYSIS IN THE TIME DOMAIN," VOLUME 1, REVISION 2

AREVA NP, INC.

PROJECT NO. 728

1.0 Steady-State Comparison of All Ramona5-Fa Neutronic Methods

For a typical reactor condition, provide the steady-state, 3-Dimensional (3D), 2-group neutron flux and power distributions calculated by: (1) MICROBURN-B2, (2) RAMONA5-FA PRESTO-1 Method, (3) RAMONA5-FA ADAPKIN Method, and (4) RAMONA5-FA ADAPKIN-M Method. Quantify and explain the maximum node-power differences.

2.0 Comparison of All Ramona5-Fa Neutronic Methods After a Pressure Perturbation

For the steady-state conditions of RAI question 1.0, initiate a transient by increasing the reactor pressure. Provide the 3D, 2-group neutron flux and power distributions calculated by the four neutronic methods after power is stabilized. Quantify and explain the maximum node-power differences.

3.0 Comparison of All Ramona5-Fa Neutronic Methods After a Subcooling Perturbation

For the steady-state conditions of RAI question 1.0, initiate a transient by decreasing the feedwater temperature. Provide the 3D, 2-group neutron flux and power distributions calculated by the four neutronic methods after power is stabilized. Quantify and explain the maximum node-power differences.

4.0 Comparison of All Ramona5-Fa Neutronic Methods After a Control Rod Perturbation

For the steady-state conditions of RAI question 1.0, initiate a transient by fully inserting one control rod and fully withdrawing a symmetric rod. Provide the 3D, 2-group neutron flux and power distributions calculated by the four neutronic methods after power is stabilized. Quantify and explain the maximum node-power differences.

5.0 Limitations for Each Neutronic Method Application

State the limitations for the three RAMONA5-FA neutronic methods (PRESTO-1, ADAPKIN, and ADAPKIN-M). State what type of transients are applicable to each method **[ ]**.

6.0 Decay Heat Benchmark

Establish a null transient at full power for an arbitrary reactor condition. Provide the decay heat power as function of time following a reactor shutdown.

7.0 Define Ramona5-Fa Stability Configuration

Define which RAMONA5-FA options were used for the stability benchmarks reported in Chapter 5 of TR BAW-10255(P), "Cycle-Specific DIVOM [Delta CPR [critical power ratio] over Initial CPR Versus Oscillation Magnitude] Methodology." Based on these benchmarks, specify the required RAMONA5-FA option configuration for stability and/or DIVOM calculations (e.g., use ADAPKIN-M method, select the STAIF fuel pin models…).

8.0 Fuel Pin Models

Provide an electronic copy of EMF-CC-074(P)(A), Volume 4, Revision 0, BWR Stability Analysis-Assessment of STAIF with Input from MICROBURN-B2, Siemens Power Corporation, August 2000. Indicate the sections where the STAIF fuel pin models that have been imported into RAMONA5-FA are described. Provide any additional benchmark or validation data relevant to these models.

9.0 Direct Heat Deposition Models

RAMONA5-FA can import a direct heat deposition model from MICROBURN-B2 as function of moderator density. Provide an example for the typical reactor condition of RAI question 1.0. Describe the bases and/or validation data for the MICROBURN-B2 models.

10.0 Void Correlation

DIVOM analysis uses the **[ ]** correlation. However, the AREVA methodology specifies the **[ ]** drift flux correlation. Provide void profile comparison for a typical channel for both correlations using MICROBURN-B2 with **[ ]** and RAMONA5-FA with **[ ]** to demonstrate consistency between the RAMONA5-FA calculations and the standard AREVA methodology.

11.0 Void Correlation Uncertainty

Provide a void comparison for the Karlstein Thermal Hydraulic (KATHY) facility experiments versus the **[ ]** predictions. Identify an uncertainty value associated with **[ ]** application to Atrium-10. Artificially bias **[ ]** parameters so that new upper- and lower-bound correlations are developed that enclose most KATHY Atrium-10 experimental data (not all data, specially at low qualities, need to be bound – only voids >50 percent are relevant).

12.0 Propagation of Void Correlation Uncertainty

Replace the standard **[ ]** correlation with the upper-bound and lower-bound correlations in RAMONA5-FA. Run a simplified case to estimate the change in DIVOM slope with these two new correlations. Run a decay ratio prediction and estimate the impact of this upper-bound correlation uncertainty. These numbers will represent an upper-bound of the uncertainty propagation and they will be significantly larger than the expected error.

Repeat the above exercise by replacing the **[ ]** correlation with **[ ]**. These numbers will be closer to a best-estimate of the uncertainty propagation.

Note: this exercise may require the use of a temporarily modified and unverified copy of RAMONA5-FA, which is acceptable for this purpose.

13.0 Pressure Drops

For the typical reactor of RAI question 1.0, provide the channel pressure drops and the 2-Dimensional core flow distribution for RAMONA5-FA and MICROBURN-B2. Provide a benchmark of RAMONA5-FA predictions of pressure drop in KATHY experiments, if available.

14.0 Non-Equilibrium Boiling Correlation

Provide benchmark data between the KATHY measurements and RAMONA5-FA predictions for the sub-cooled boiling region.

15.0 CHF Correlation for DIVOM Application

Provide benchmark data to justify the use of the ANFB-10 and Siemens Power Corporation B (SPCB) correlation critical heat flux for oscillatory flow conditions. Note: this is the same information already provided to the Office of the Advisory Committee on Reactor Safeguards and the U.S. Nuclear Regulatory Commission (NRC) staff.

16.0 Ramona5-Fa Nodalization and Data Flow

Provide a short description of the RAMONA5-FA nodalization and data flow.

17.0 Ramona5-Fa DIVOM Calculation Guidelines

Provide a copy of the RAMONA5-FA guidelines for cycle-specific DIVOM calculations (Report EMF-2001(P)).

18.0 Use of Future CPR Correlations

Define the process to be used to implement future CPR correlations in the DIVOM calculation procedure. Define what criteria will be used to evaluate whether a new CPR correlation needs to be benchmarked against oscillatory dryout-rewet data.

19.0 ACE CPR Correlation

AREVA has developed a new CPR correlation (ACE), which has been reviewed by the NRC staff for steady-state and transient operation. Since the form of the ACE correlation is significantly different than older approved correlations, provide justification of the applicability to oscillatory dryout-rewet conditions.

20.0 Define Threshold Value for Insignificant DIVOM Slope Changes

Provide a description of the process used to determine the envelope (upper and lower bounds) of the DIVOM correlation for expected variations in a typical DIVOM correlation. This envelope can be used in the future to identify whether any future methodology changes affect the DIVOM slope in a statistically significant way. Provide data to justify the use of the **[ ]** and **[ ]** value as the threshold for a “statistically insignificant” or “small” DIVOM slope change, respectively.

21.0 Bypass Boiling

Provide information about the response of RAMONA5-FA to bypass boiling oscillations during power oscillations.

22.0 Ramona History

Provide a short description of the RAMONA code history.